

# Analysis of the coal production chain from the caatinga vegetation in the rural area Petrolina – PE

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**Abstract**— This paper aims to present the results obtained from the execution of the Project entitled “Analysis of the charcoal production chain from the caatinga vegetation in the Rural Zone of Petrolina – PE”, approved in the selection of Public Notice n°. 55/2018 as the Initiation Grants Project. Scientific - PIBIC of the Federal Institute of Pernambuco Sertão – Petrolina campus. The main objective was to make an analysis of the charcoal production chain in the respective municipality, listing the environmental impacts caused to the native vegetation of the caatinga ecosystem, the fauna and the local society through the charcoal production. This is an applied, exploratory, descriptive and field research, where it was possible to make an exhaustive study of the literature and perform in loco the survey of the main caatinga trees used for coal production in the region. The results indicate the need for discussion of several important points in this agenda that should be discussed in the academic-scientific and political-social, aiming to point out the harmful consequences to the environment and society.

**Keywords**— Environmental impact, Charcoal plants, Caatinga.

## I. INTRODUCTION

Human beings have been accustomed to using firewood as an energy source since the creation of fire, and to this day continue to be widely used for various purposes, such as pulp, paper and charcoal manufacturing, for example. According to Goldemberg and Lucon (2006), the use of firewood in Brazil is significantly important, both in the generation of primary energy in household food cooking and in the generation of secondary energy through charcoal.

Charcoal production is an important activity for family farming in the region and is considered by many to be a source of income generation. Nationally, this is also a large-scale practice produced in different contexts. So while coal is produced in an environmentally and socially acceptable way, unfortunately it is also produced in contexts of environmental destruction and exploitation of cheap labor.

From 1979 to 1988 the rate of consumption of charcoal from native forest showed an increase of 189%, while the rate of consumption of charcoal from planted forests grew

by 369%, providing the equivalent of 16 million cubic meters of wood to charcoal production (BRITO, 1990).

Rezende and Santos (2010) state that there are few studies on the charcoal production chain, and no specific systematic studies on the dynamics and structure of the charcoal chain were found, revealing the analysis of the interrelationships between the agents.

Oliveira (2003) points out that, in recent years, population growth, technological advances and the fossil fuel crisis have increased the pressure on the native flora of many regions, in different parts of the world, including Brazil, in various forms, highlighting the production of firewood and charcoal.

Based on these assumptions and in view of the immense plant richness present in Brazilian soils, especially in Caatinga, and the few studies related to coal production using the species of this exclusively Brazilian biome, this work aimed to analyze the coal production chain in the city of Petrolina – PE this coal originates from the native vegetation of the caatinga, listing the environmental impacts caused to the native vegetation of

the caatinga ecosystem, the fauna and the local society through the production of charcoal.

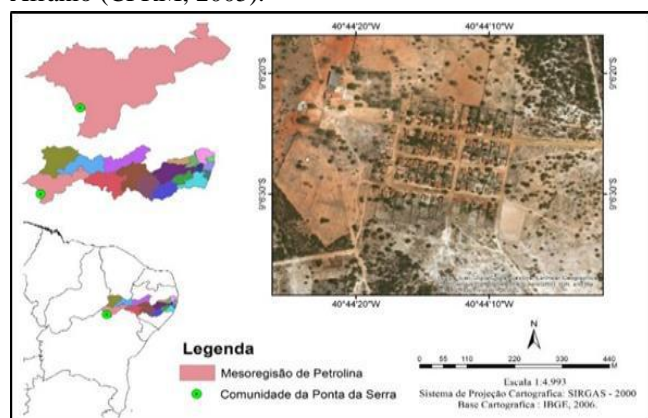
The focus area of this investigation was the charcoal plants of rural Petrolina – PE and surrounding regions, aiming to analyze indicators such as: productivity, resources and raw material, product quality and environmental damage, seeking to understand all such processes to delimit the situation around the charcoal, specify problems caused to the soil, vulnerabilities caused in the local fauna and flora and, from there, draw an economic, social and environmental diagnosis in order to find strategies for the reduction of environmental and environmental impacts of clandestine charcoal plants.

This is an applied, exploratory, descriptive and field research, where it was possible to make an exhaustive study of the literature and perform in loco the survey of the main caatinga trees used for coal production in the region. The results indicate the need for discussion of several important points in this agenda that should be discussed in the academic-scientific and political-social, aiming to point out not only the harmful consequences to the environment and society, but also to present mitigation proposals for these areas.

## II. MATERIALS AND METHODS

### 2.1. Location

The research was conducted in the rural area of Ponta da Serra, in the municipality of Petrolina/PE, located in the state of Pernambuco (map 1). The municipality of Petrolina is located in the São Francisco mesoregion and the Petrolina microregion of the state of Pernambuco, limited to the north with Dorments, south with Bahia State, east with Lagoa Grande, and west with Bahia State and Afrânio (CPRM, 2005).



Map 1: Search Location

Source: Pacheco (2020)

The municipality of Petrolina, is inserted in the geoenvironmental unit of the Depression Sertaneja, which represents the typical landscape of the northeastern

semiarid, characterized by a very monotonous pediplanation surface, predominantly smooth-undulating relief, cut by narrow valleys, with dissected slopes. Residual elevations, ridges and/or hills punctuate the skyline. These isolated reliefs testify to the intense erosion cycles that affected much of the northeastern backcountry (CPRM, 2005).

The vegetation is basically composed of hyperxerophilous caatinga (figure 1) with stretches of deciduous forest.



Fig. 1: Vegetation of the caatinga ecosystem in the surveyed area

Source: Souza (2019)

The climate is tropical semi-arid, with summer rainfall, and the rainy season begins in November and ends in April, with average annual rainfall around 431.8mm. With regard to soils, in the Long and Low Levels Slopes of the gentle undulating relief occur the poorly drained planosols, average natural fertility and salt problems; in the Tops and High Strands, the non-calcic, shallow and high natural fertility soils; in the tops and high slopes of the undulating relief occur the podzolics, drains and average natural fertility; and in the residual elevations there are the litholic, shallow, stony soils and average natural fertility (CPRM, 2005).

### 2.2. Research Typology

This research is presented as descriptive, which aims to observe, record, analyze and correlate phenomena or facts, without interfering with the analyzed environment, being the type of research most used in the social sciences (VIEIRA, 2002; MALHOTRA, 2001). As for the purposes of this research, it was constituted of the exploratory type, because they propose to make a bibliographical survey and interviews in the communities that have their income focused on the charcoal manufacture, with the purpose of getting used to the problem. Thus, it constitutes an exploratory and descriptive research.

It is also exploratory, as there are not enough scientific productions focused on this theme focusing on the rural communities of Petrolina – PE, where there is a large amount of charcoal production. Descriptive because it aims to know and describe the actors of a specific market as well as understand their behavior for the formulation of strategies (VERGARA, 1988, p. 35).

The work began with a survey of bibliographic sources, analyzing already consolidated studies on the coal production chain, environmental impacts, and the main native caatinga trees used in the Caatinga rural communities of Petrolina, Pernambuco State, with to point out the main impacts in the region. From what was previously mentioned, to reach the proposed objectives, the following steps were traced: the theorists that deal with the charcoal chain, the Caatinga ecosystem and the tree species used in predatory deforestation were read, coal production, as well as its immediate and medium and long term impacts on the soil. For this, it was made the choice of scientific articles published in Scielo, Periodicals Capes, Google Scholar that address these issues.

After reading there was a brief discussion of the most relevant points of reading, between coordinator and students in order to talk about the main points of the research. After the readings, files and discussions, we set out to develop a field research script, carried out in the rural communities of the municipality focus of the research. In the field research, it was analyzed landscape, soil, vegetation and charcoal manufacturing processes, where the obtained results raised the stability level of the research focus area.

As a method of data discussion analysis, a comparison was made between the concepts found in journals and the data obtained in field research. From this, the real conclusion is reached of what is the situation of the local fauna and flora. Based on this, an intervention proposal was elaborated that will take into consideration the physical and social aspects.

### III. RESULTS AND DISCUSSIONS

It was verified through the readings that address the thematic chain of charcoal production, that the process of charcoal production begins with the drying, loss of free or capillary water and adhesion water and with the transformation due to physical thermal decomposition, irreversible chemical (FREDERICO, 2009).

Total or partial degradation of wood and the elimination of volatile components are caused by the action of heat. This phenomenon is called pyrolysis, one of the oldest phenomena that presents as a result a series of products, including charcoal. However, this process is

associated with the oven temperature level (BRITO, 1990). Carbonization enters with air to partially burn wood volatiles, providing the necessary energy for the process (SAMPAIO, 2008).

Charcoal production occurs in charcoal plants. The name of charcoal (Figure 3) is the place where the furnaces are concentrated and the operations that involve the activities of receiving and dispatching coal production (BRITO, 1990). Coaling is the process of transforming wood into coal (VITAL; PINTO, 2011).



Fig. 3: Charcoal in the research area

Source: Souza (2019)

There are different types of charcoal for charcoal production, some with the application of technologies that are designed to reduce social and environmental impacts and increase efficiency, and others with a rudimentary process characterized by low productivity and large social and environmental impacts (MOTA, 2013).

Based on this information, we sought to know more about the theme by seeking information on the existing charcoal in rural areas of Petrolina-PE, where it has already been noticed the large number on the outskirts of the city. Through on-site visit, it was possible to verify what is described in the literature about the main trees used in predatory deforestation for charcoal production, such as the black jurema (*Mimosa tenuiflora*), the Jureminha (*Desmanthus virgatus*), the angico (*Anadenanthera colubrina*) and the cating tree (*Caesalpinia pyramidalis* Tul.) (Figure 4).

The Black Jurema - *Mimosa tenuiflora* is a small tree that grows to 7m in height. The stem is lined with sparse thorns in the younger parts, but adult thornless plants can be found in the Caatinga. The leaves are composed of small leaflets, with forage quality in the feeding of goats and cattle. The flowers are white, arranged in spike inflorescences and have apicultural potential. The wood is used for piles, firewood and coal of high calorific value (4,150 Kcal.m-3) (EMBRAPA, 2010).





Fig. 4: Main caatinga devastated species

Source: Pacheco (2019)

Already Jureminha - *Desmanthus virgatus* is a perennial shrub legume, widely occurring in the Northeast. It may also be known as anise-debode, worm's cinnamon, black reed, saracura feather and cowboy's bark, totaling 24 species (LUCKOW, et. al., 1993)

Angico - *Anadenanthera colubrina*, in turn, is a medium-sized tree, reaching up to 15m in height, with thick and very rough bark. The leaves are composed of 20 to 80 leaflets, always in pairs. The cream-colored brush-shaped flowers are clustered in globular inflorescences. The fruits are flat, thin, long and dark colored pods (EMBRAPA, 2010). The leaves are toxic to cattle, but when hay or dried together with the young branches, they are excellent fodder for cattle, goats and sheep. The wood is used for stakes, posts, firewood and coal of high calorific value (3850 cal.g-1).

According to studies by Embrapa Semi-arid, at 8 years of age, Angico presented average height of 3.7m and diameters at breast height of 4.7cm with an average annual increment of 1.1m<sup>3</sup> / ha year-1, indicating that this species can be considered as a good option for production (EMBRAPA, 2010).

The Catingueira - *Caesalpinia pyramidalis* Tul., can be used for various purposes, including animal feed, its leaves that sprouted after the onset of rain can be an important source of forage; presents honey potential in both pollen and nectar production and shelter for stingless wild bees of the genus *Melipona* and *Trigona*, which nest in the hollows of the trunks. In addition, it may have energy use as firewood. In home medicine, the species can be used due to its antidiarrheal properties (use of leaves, flowers and bark) and in the treatment of hepatitis and anemia (use of bark) (MATIAS; SILVA; DANTAS, 2017).

In the field research (figure 5) it was possible to understand how the charcoal production process is constituted. The procedure can basically be done as follows: first, a ditch is dug in the ground and around that ditch are made openings, ie passages where smoke will

escape, then placed in the ditch neatly and stacked, the caatinga wood already cut, and on the woods is placed some kind of vegetable such as grass or grass.



Fig. 5: Ongoing stream for the coal manufacturing process

Source: Souza (2019)

After this procedure, the fire is covered with earth, the fire is placed in one of the mouths that is then capped so that the smoke comes out in the other openings, it will produce a lot of smoke, after this smoke ceases and only fire is closed, all openings so that no more oxygen can enter and so the wood turns to charcoal. If not done this way, the wood turns to gray.

Small farmers have for years been extracting firewood [caatinga hardwood by stem thickness] for charcoal production (figure 6), fencing, and especially for traditional crops such as corn and beans. There is another side of the story that needs to be discussed, that is, this increase in the rate of deforestation of the caatinga is primarily due to the demand for firewood and charcoal from large industrial complexes in the northeastern capitals (FOTOS E FATOS DA CAATINGA, 2013).



Fig. 6: Firewood used in chairs

Source: Souza (2019)

In some areas of the Sertão de Pernambuco, especially in the borders of the municipalities of Serra Talhada and Custódia, this activity is contributing to the devastation of caatinga, since coal is produced on a large scale and sold to industries in the capital Recife (FOTOS E FATOS DA CAATINGA, 2013).

It is clear from past experiences that most charcoal-dwellers survive on their income and have no other source of survival. There are large-scale fabrications where people work for a boss; and on a small scale, where they work for themselves and for family support.

It is possible to classify charcoal producers into groups: professional producers (those who produce charcoal with wood purchased from forests of farmers and reforesters); potential producers (arise at the time of high product prices); independent producers (group of self-employed forest planters who use surplus wood for charcoal production and those who use wood from forest management) and fostered producers (those who receive incentives from charcoal consuming companies) , according to Barcellos classification (2016); Rezende; dos Santos (2010).

However, Santos (2017) states that:

The sustainability of the charcoal production process is based on ensuring the permanence of the activity in accordance with: (i) the ability of natural resources not to be compromised by the use of raw materials from renewable sources and that the management is adequate to do not harm the environment; (ii) the ability to make the best use of available resources through the use of technologies and good manufacturing practices; (iii) ensuring that human beings will be respected in their elementary needs, both those involved in the activity and those around them; (iv) respect for the environment by the non-emission of pollutants and compliance with relevant legislation; and (v) the economic viability of the activity in generating sufficient earnings to maintain the activity and without harming the environment (SANTOS, 2017, p. 120).

It is evident, therefore, that the rudimentary practice harms the environment, as, for example, some woods used could be better used for medicinal purposes, such as the use of angicos in folk medicine, where it is used by extracting the principles curative actives by peel or gum (resin), by infusion, syrup, maceration or tincture.

The angicos bark is rich in tannins, mucilages and alkaloids that have hemostatic, depurative, astringent,

healing and pectoral emulsifier medicinal action being very suitable to treat: coughs, pertussis sexual diseases, uterine problems bruises among others, not to mention the environmental issue itself said (BRITO et. al., 2016).

However, it is also inevitable that many people still need to do this manufacturing because of their financial conditions and where they live. Many rural communities still make a living from selling coal, they make small-scale use of dead wood, produce what they need for a living, and live in fear of being punished in some way by the competent authorities of the environmental crime bodies, such as the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), even if these people manufacture charcoal without causing deforestation of the caatinga, just reusing dead vegetation.

On the soil of the waterfalls (figure 7) it was possible to notice that over time the “black earth”, soil coming from where the charcoal production takes place is a great alternative to be used for fertilization. Some residents of the analyzed region make use of the inactive waterfall soil in irrigation projects and there are empirical reports that the soil is very effective for fertilizing plants such as guava, hoses and coconut trees. They also add that these so-called “useless” and polluting soils are now in good use.



Fig. 7: Inactive Caieiras

Source: Souza (2019)

From this study, it was concluded that the competent authorities must fulfill their obligations to soften the clandestine charcoal production in the municipality, focusing especially on the large-scale ones, which really do the greatest devastation of the caatinga and profit, with the raw materials of the ecosystem.

Small-scale manufacturing needs to be recognized as an environmentally friendly action because natural wood from dead vegetables is used. In addition, all charcoal that is produced on a small scale stays in the municipality for domestic consumption, bringing benefits to the residents themselves and assisting in family farming through the use



of rich and beneficial soil for the cultivation of food species.

#### IV. CONCLUSION

This research was crucial to verify the main impacts of charcoal production in the region, since there are few literature on this subject. It is concluded based on the readings and discussions, that the objective was achieved and that the research in question is of fundamental relevance, as it showed an existing reality in the city of Petrolina-PE in which before had not been discussed.

It was possible to understand how a charcoal system works, how charcoal is actually made in some regions and this has given impetus to field research, in which it was possible to demystify many previous questions and statements.

In addition, the research also made the academic, political and social view of this issue bring to the public knowledge of the city of Petrolina-PE, about the charcoal chain, the Caatinga ecosystem and the tree species used in predatory deforestation for coal production, as well as its immediate, medium and long-term impacts on the soil.

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